MATH 241 Dr. Wolfe SAMPLE FIRST HOUR EXAM SPRING 2007

The Use of Calculators Is Not Permitted On This Exam

1. Let $\mathbf{a} = (2, 1, -1)$, $\mathbf{b} = (5, 0, 1)$, $\mathbf{c} = (10, 1, 1)$.
(a) Find parametric eqations for the line L containing $\mathbf{a}$ and $\mathbf{b}$.
(b) Find symmetric equations for the line through $\mathbf{c}$ parallel to L.
(c) Find an equation of the plane P containing $\mathbf{c}$ and perpendicular to L.
(d) Find the point of intersection of the line L and the plane P.
(e) Find the distance from the point $\mathbf{a}$ to the plane P.

2. The position vector of a particle at any time t is given by

$$\mathbf{r}(t) = \frac{4}{5}\cos t\,\mathbf{i} + (1 - \sin t)\,\mathbf{j} - \frac{3}{5}\cos t\,\mathbf{k}.$$

(a) Find the velocity, acceleration, and speed of the particle at any time t.
(b) Find the tangential and normal components of the acceleration vector at any time t.
(c) Find the curvature of the trajectory at any time t.

3. Let $\mathbf{a}$, $\mathbf{b}$, $\mathbf{c}$ be as in problem 1. Find the area A of the triangle whose vertices are $\mathbf{a}$, $\mathbf{b}$ and $\mathbf{c}$.

4. A ball rolls off a horizontal roof of a building 144 feet tall with a speed of 24 feet per second. How far away from the building is it when it hits the ground? Take $g = 32$ feet per second per second.

5. Mark each statement as true (T) or false (F) (no reasons needed).
(a) If $\mathbf{u}$ and $\mathbf{v}$ are orthogonal unit vectors, $\mathbf{u} \times \mathbf{v}$ is a unit vector.
(b) If $\mathbf{u}$, $\mathbf{v}$ and $\mathbf{w}$ are vectors then $(\mathbf{u} \cdot \mathbf{v}) \times \mathbf{w} = \mathbf{u} \cdot (\mathbf{v} \times \mathbf{w})$.
(c) A vector-valued function $\mathbf{r}$ defined on an interval I is smooth if $\mathbf{r}$ has a continuous derivative on I.
(d) If a smooth space curve C has its curvature $\kappa(t)$ identically zero then C is a line (or a line segment).
(e) If a particle moves with constant speed, its velocity and acceleration vectors are orthogonal.